REMARKS:

I. Status of the Application.

In the Office Action mailed August 20, 2008 (the "Office Action"): (1) claims 1 – 5, 7 – 26, 29 and 30 were rejected as unpatentable under Section 103(a) based on Duncan et al. U.S. Patent Application Publication No. US 2003/0030497 ("Duncan" or the "Duncan reference") in view of McCorquodale et al. U.S. Patent No. 6,972,635 ("McCorquodale" or the "McCorquodale reference") (Office Action, pages 2 - 4); (2) claims 6, 28, 31 and 32 were rejected as unpatentable under Section 103(a) based on Duncan in view of McCorquodale in further view of Hayashi et al. U.S. Patent No. 5,180,995 ("Hayashi" or the "Hayashi reference") (Office Action, page 4); and (3) claim 27 was indicated as allowable if rewritten in independent form and including all of the limitations of the base claim and any intervening claims (Office Action, page 5).

Claims 1, 2, 4 – 14, and 16 – 39 are pending, of which claims 33 – 39 are new, with claims 3 and 15 having been cancelled. New claims 33 – 35 depend from claim 1, and new claims 36 – 39 depend from claim 16. Independent claims 1, 16 and 30 have been amended, as discussed in greater detail below. Extraneous claim language ("adapted") has also been deleted to more precisely claim the structure of the present invention. Several of the new dependent claims (such as claims 33 – 39) also now provide for several different types of reactances which may be utilized in the exemplary embodiments, such as variable capacitances (controlled using a control voltage). No new matter has been introduced.

Upon entry of this amendment, independent claims 1, 16 and 30 have been amended to more distinctly point out and claim the invention, which provides a "master" or "reference" LC oscillator which provides a reference signal at a calibrated resonant frequency, coupled to a frequency controller or temperature compensator which maintains the resonant frequency substantially constant in response to a variation of a parameter, such as a temperature or voltage variation. The amendments should provide clarification for the Patent Office which shows that the Duncan reference is completely inapplicable to and teaches away from the present invention, as the Duncan reference concerns a "slave" oscillator which can only function when phase locked in a PLL loop to an externally supplied, reference crystal oscillator which provides a fixed reference frequency. The Duncan reference does not disclose and does not suggest any

mechanism for maintaining the resonant frequency of the *reference oscillator* substantially constant over a variation of a parameter, such as a temperature or voltage variation, and therefore does not anticipate and does not render obvious the present invention as claimed.

The McCorquodale reference, by one of the inventors herein, concerns using a MEMS-based LC oscillator as a reference oscillator, and does not disclose and does not suggest the claimed frequency control, namely, maintaining the resonant frequency substantially constant over such a parameter variation. Combining the McCorquodale reference with the Duncan reference would merely provide for a MEMS-based LC-oscillator used as a reference oscillator in Duncan, with the Duncan frequency control still provided via phase locking in a PLL loop, without any control over the reference frequency itself.

Accordingly, the Duncan reference and the McCorquodale reference, alone or in combination, do not disclose and do not suggest the present invention. Applicants respectfully traverse the rejections and requests reconsideration of the pending claims in view of the amendments and the following remarks.

II. The Rejection of the Claims Under Section 103(a) Should be Withdrawn.

The present invention, as claimed in independent claims 1, 16 and 30 as amended, is completely different than the methods and apparatuses disclosed and suggested in the Duncan reference. The claims specifically provide that the resonator (or oscillator) of the present invention is a "master" or "reference" oscillator, and is not the "slave" or phase-locked oscillator of Duncan which requires locking to a separate, external crystal reference oscillator. Because the present invention concerns a reference oscillator, the entire circuit structure as claimed is also completely different than the disclosure of Duncan.

Specifically with regard to independent claims 1, 16 and 30, the Duncan reference does not disclose the following claimed elements, structure, and combination of elements in their structural relations: (1) a reference resonator to provide a reference signal having a resonant frequency, comprising an inductor and a capacitor; (2) a negative transconductance amplifier coupled to the reference resonator; (3) a frequency controller (or temperature compensator) which is coupled to the reference resonator; in which the frequency controller is adapted (4) to maintain the resonant frequency, (5) substantially constant (6) in

response to a variation of a parameter, such as (7) temperature, fabrication process, voltage, and frequency (from dependent claim 2).

A. The Duncan Reference Concerns Very Different and Inapplicable Circuitry and Teaches Away from the Claimed Invention.

The Duncan reference instead discloses using two oscillators which have a very different circuit structure and different circuit elements, namely, a phase-locked loop ("PLL") having a second, "slave" voltage-controlled LC oscillator ("VCO") which is locked via the PLL to a fixed resonant frequency provided by the first oscillator, an off-chip quartz crystal reference oscillator. The frequency of the output signal in the circuitry of Duncan is, at all times, determined by the divide/multiply ratios of the PLL and the fixed reference frequency provided by the crystal reference oscillator. Accordingly, there is no frequency controller in Duncan which is coupled to the reference oscillator and which can maintain the resonant frequency of the reference oscillator substantially constant in response to a parameter variation, such as temperature and voltage. Rather, in Duncan, a control voltage from the PLL drives the VCO to lock to this reference frequency. The Duncan reference does not disclose and does not suggest the claimed methodologies for compensating for changes in the resonant frequency of the reference signal which would otherwise occur due to temperature, voltage or other parameter variations, which thereby provides a stable reference signal at a calibrated frequency (also without any phase or frequency locking, as required by the Duncan reference).

Similarly, with regard to independent claim 16 as amended, the Duncan reference does not disclose the additional claimed elements of: (1) a temperature compensator coupled to the reference resonator, with (2) the temperature compensator to maintain the resonant frequency substantially constant in response to temperature variation. Duncan also does not disclose the additional claimed elements of independent claim 30, such as: (1) a current mirror coupled to the negative transconductance amplifier; and (2) a current source coupled to the current mirror, with the current source maintain the resonant frequency substantially constant by varying a current in response to temperature.

Having specified that the claimed invention provides the reference signal using the reference oscillator, all the other significant circuitry differences with the prior art become readily apparent. For example, the claimed structures and connections of all of the surrounding

circuitry are quite different in the present invention, because the present invention is directed to controlling the reference oscillator, and is not about making sure that a slave oscillator has sufficiently high transconductance (g_m) in Duncan to sustain oscillation for locking to an external oscillator. For example, there is nothing in the Duncan reference which discloses or suggests that a frequency controller both is coupled to the reference oscillator (rather than a second, VCO slave oscillator) and that it can maintain the frequency of the reference signal (which would otherwise change) provided by its external quartz crystal reference oscillator in response to a parameter variation, such as temperature.

The Duncan reference specifically concerns a "slave" or "phase-locked" oscillator, which can only function when locked to the fixed-frequency reference signal provided by an externally-supplied, off-chip quartz crystal reference oscillator. The circuitry of the Duncan reference is totally useless without being locked to the crystal reference oscillator, and must specifically rely on the crystal reference oscillator to provide the fixed reference frequency for all of its various receiver functions. The frequency of the output signal in the circuitry of Duncan is, at all times, determined by the divide/multiply ratios of the PLL and the fixed reference frequency provided by the off-chip quartz crystal reference oscillator. None of the changes in current provided to the amplifier of the VCO in Duncan affects the output frequency, but only affects the linearity of the frequency response of the VCO to its control voltage and the ability of the VCO to sustain oscillation for locking to the crystal reference oscillator, *i.e.*, satisfy the Barkhausen criteria for the voltage-controlled LC oscillator so that it can lock to the fixed reference frequency of the crystal reference oscillator.

More specifically, the Duncan reference, as discussed above, requires an external, off-chip crystal reference oscillator. (Duncan reference, paragraphs 208, 209, 210, 214, 251, 259, Figures 7, 17, 18, 46a (external crystal reference XTAL 4606), Figures 51 – 53 (external crystal reference oscillator XTAL 4808)). The Duncan reference then combines a PLL with the crystal reference oscillator, and uses a second, voltage controlled "slave" oscillator which is locked to the crystal reference oscillator (Duncan reference, paragraphs 251, 252, 253), with one PLL used to provide coarse tuning, and another PLL used to provide fine tuning of the second, voltage controlled "slave" oscillator (Duncan reference, paragraphs 259, 283).

The "tuning control circuit" of the Duncan reference is not coupled to the reference oscillator, but is coupled to the second, voltage controlled "slave" oscillator (Duncan

reference, paragraphs 517, 524, 526). As specifically illustrated in Figure 46a of Duncan, the tuning control circuit 4535 is coupled to the second, voltage controlled "slave" oscillator 4532, not to the crystal reference oscillator, to create a window or range of tuning so that it can lock to the fixed frequency provided by the PLL and crystal reference oscillator, but has no effect of any kind on the frequency of the reference oscillator 4606.

Another truly significant difference between the present invention as claimed and the Duncan reference is the fact that the reference signal provided by the reference oscillator is not calibrated or tuned in the Duncan reference, but is fixed at all times. To insure locking over temperature changes which might move the "window" or range of locking capability, the Duncan reference compares (4634 and 4636) the control voltage 4533 coming from the PLL to reference voltages V1 and V2 across two resistors, to adjust the high and low sliding windowing range to enable the VCO to lock to the off-chip quartz crystal reference oscillator in the PLL, and to prevent the VCO from being out-of-range for locking to the fixed reference frequency provided by the external crystal reference oscillator (Duncan reference, paragraphs 569 – 571).

Any changes in the current or transconductance (g_m) of the VCO in Duncan, then, have no effect on either the reference frequency provided by the reference oscillator, or the output frequency provided by the VCO, which is phase locked to the reference frequency provided by the reference oscillator. Rather than modulating the current or transconductance (g_m) provided to the reference oscillator to maintain the reference frequency, as claimed in the various dependent claims, Duncan does the opposite, and seeks to minimize any changes in transconductance (g_m) (Duncan reference, paragraph 389) and create circuitry so the transconductance (g_m) is "maximally flat" (*i.e.*, constant) to provide a "linear current verses voltage curve" (Duncan reference, paragraph 427). Clearly, the Duncan reference discloses a very different circuit structure than that of the present invention.

The Duncan reference also does not disclose and does not suggest many claimed features from the dependent claims, in addition to those dependent claims already considered allowable. For example, the Duncan reference does not disclose a frequency controller coupled to the reference resonator which is further adapted to modify a current through a negative transconductance amplifier in response to temperature, with the frequency controller further comprising a current source responsive to temperature, and wherein the current source has one or more configurations such as CTAT, PTAT, and $PTAT^2$ configurations. While there are many

more differences, in the interests of brevity, the remaining dependent claims will not be discussed separately.

Because the Duncan reference requires such an external crystal reference oscillator, because the output frequency is always determined by the divide/multiply ratios of the PLL and the fixed reference frequency provided by crystal reference oscillator, and especially because Duncan provides no mechanism to maintain the resonant frequency of the reference oscillator substantially constant over parameter variations such as temperature, <u>Duncan would lead an inventor in a divergent direction, and thereby teaches away from the present invention</u>. MPEP Section 2141.02. *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006), cited approvingly in *KSR International Co. v. Teleflex Inc. et al.*, April 30, 2007 Slip Op. at 14, 550 U.S. __, 127 S. Ct. 1727, 82 U.S.P.Q.2d 1385 (2007).

Such teaching away is the antithesis of art suggesting that a person of ordinary skill go in the claimed direction. See *In re Fine*, 873 F.2d 1071 (Fed. Cir. 1988). This teaching away from Applicant's invention is a *per se* demonstration of lack of obviousness and a lack of anticipation. Indeed, in the *KSR International* decision, the Supreme Court affirmed that such teaching away is a substantial indication of non-obviousness of the invention. April 30, 2007 Slip Op. at 12.

B. The McCorquodale Reference Does Not Disclose and Does Not Suggest Any Mechanism for Frequency Control of the Claimed Invention.

The McCorquodale reference, by one of the inventors herein, concerns using a MEMS-based LC oscillator as a reference oscillator, and does not disclose and does not suggest the claimed frequency control, namely, maintaining the resonant frequency substantially constant over a parameter variation, such as temperature variation. The only mechanism disclosed in the McCorquodale reference is for tuning for selection of the resonant frequency through tuning of bypass capacitors 80, with a control input voltage applied through a MOS resistor 82, to block the DC tuning voltage to the top plates 42 of the MEMS varactors 40. (McCorquodale reference, Col. 19, ll. 59 – 66).

Combining the McCorquodale reference with the Duncan reference would merely provide for an LC-oscillator as a reference, with the Duncan frequency control still provided via phase locking in a PLL loop, <u>without any control over the reference frequency</u>

<u>itself, and certainly no compensation for frequency changes that would occur due to temperature, voltage, and other parameter variations.</u> Accordingly, the Duncan reference and the McCorquodale reference, alone or in combination, do not disclose and do not suggest the present invention.

The claimed invention also has novel elements which were not disclosed in the prior art whatsoever, such as frequency control for an LC reference oscillator to maintain a resonant frequency substantially constant over changes in parameters, such as temperature variation, so the independent claims are not a matter of a combination of elements found in the prior art, unlike the patent claim at issue in *KSR International*, April 30, 2007 Slip Op. at 11, 550 U.S. __, 127 S. Ct. 1727, 82 U.S.P.Q.2d 1385 (2007). Because the prior art does not disclose these novel elements, "an obviousness [rejection] cannot be sustained by mere conclusory statements" and there can be no "rational underpinning" for such a conclusion. *In re Kahn*, op cit.

In addition, identification of any individual part claimed is insufficient to defeat patentability of the whole claimed invention. See *In re Kotzab*, 217 F.3d 1365 (Fed. Cir. 2000). Identification of parts or components, for example, such as an LC oscillator, does not disclose and does not suggest the claimed structure of the embodiments of the present invention, viewed as a whole, of a reference LC oscillator, coupled to a negative transconductance amplifier, and coupled to a frequency controller (or temperature compensator) to maintain a resonant frequency substantially constant over a parameter variation, such as temperature variation. Accordingly, no *prima facie* showing of potential anticipation or obviousness has been made, and any assertions to the contrary have been clearly rebutted. *In re Rouffet*, 149 F.3d 1350 (Fed. Cir. 1998); *In re Mills*, 916 F.2d 680 (Fed. Cir. 1990).

C. The Remaining Reference Also Does Not Disclose and Does Not Suggest the Claimed Invention.

The remaining Hayashi reference was cited for various dependent claims. The Hayashi reference, however, also requires a digital phase lock loop. In addition, the Hayashi reference does not disclose the claimed temperature-dependent current sources, such as CTAT, PTAT, or $PTAT^2$ configurations, but merely discloses use of two resistors having opposite temperature coefficients (Figures 3 and 5, Col. 4, ll. 41 – 52; Col. 9, ll. 27 – 42).

D. The Cited References in Related Applications Also Do Not Disclose and Do Not Suggest the Claimed Invention.

In a commonly-owned U.S. Patent Application Serial No. 11/084,962, now U.S. Patent No. 7,227,423, Bult et al. U.S. Patent Application Publication No. US 2001/0041548 was cited ("Bult"). Bult has a highly similar disclosure to Duncan, and in many instances is identical. Accordingly, as Bult does not provide any additional disclosure relevant to this application, it will not be separately addressed herein.

In an Office Action in a related U.S. application Serial No. 11/796,820, Oka et al. U.S. Patent No. 5,705,957 ("Oka" or the "Oka reference") was brought to Applicants' attention. The claimed negative transconductance amplifier of all of the independent claims was considered sufficient for patentability over Oka. In addition, the Oka reference and the other cited references, alone or in combination, do not disclose and do not suggest the claimed invention. For example and without limitation, the Oka reference regulates a crystal, piezoelectric oscillator 9 which cannot be integrated with other components (and can only be packaged together), not an LC oscillator which can be combined with the other claimed elements to form a completely integrated circuit. In addition, Oka describes a different circuit structure, without the claimed amplifier coupled to an inductor and a capacitor. Oka also provides frequency control by modifying the power supply voltage provided to a separate CMOS inverter circuit 8, which is not the reference oscillator, and therefore discloses a different circuit structure and different circuit elements, all of which are very different from the claimed invention. In the interests of brevity, however, these references and the additional differences with the claimed invention will not be discussed further.

III. Summary.

In summary, the Duncan, McCorquodale, Hayashi, Bult and Oka references references do not disclose and do not suggest the various claimed features and circuit structures of the present invention, such as the claimed elements of independent claims 1, 16 and 30 (as paraphrased): (1) a reference LC oscillator which provides a reference signal having a resonant frequency, with (2) a negative transconductance amplifier coupled to the reference resonator; (3) a frequency controller or temperature compensator which is coupled to the reference resonator,

in which the frequency controller or temperature compensator (4) maintains the resonant frequency (5) substantially constant (6) in response to a variation of a parameter, such as (from dependent claim 2) (7) a temperature variation, a voltage variation, or a fabrication process variation.

The present invention, therefore, is not anticipated and is not rendered obvious by the Duncan, McCorquodale, Hayashi, Bult and Oka references under Section 103, and the rejection of the claims should be withdrawn. In addition, because the remaining dependent claims incorporate by reference all of the limitations of the corresponding independent claims, all of the dependent claims are also allowable over the cited reference.

On the basis of the above amendments and remarks, Applicant respectfully submits that all pending claims are in condition for allowance. Reconsideration and allowance of the application is believed to be warranted, and an early action toward that end is respectfully solicited. In addition, for any issues or concerns, the Examiner is invited to call the attorney for the Applicant at the telephone number provided below.

Respectfully submitted,
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Dated: February 18, 2009

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CERTIFICATE OF ELECTRONIC FILING

I hereby certify that the foregoing Amendment and Response (17 pages), Information Disclosure Statement (1 page), and Fee Determination Record (1 page) (19 pages total), for Michael Shannon McCorquodale et al., Serial No. 10/593,356, entitled "Transconductance and Current Modulation for Resonant Frequency Control and Selection", have been transmitted electronically to the U.S. Patent and Trademark Office through the e-filing system on February 18, 2009.

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